



Complete, fold and seal
(see note 2 below)

SURNAME: Weaver

FORENAME(S): Steffan

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	WEA19823802
2	Title of Examination Paper	Electrical Power
3	Module Code	GOEE5000
4	Date and Time of Examination	15/05/2024 10:00 am
5	Examination Venue	Main Hall Tycorch
6	Seat Number	I ₂
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
Q1 a	
Q1 b	
Q2 a	
Q2 b i	
Q3 a i	
Q3 a ii	
Q3 a iii	
Q3 b i	
Q3 b ii	
Q1	12 ✓
Q2	19 ✓
Q3	16 ✓
Q4	0 ✓
Total	47/100

47

47%

Q1

a)

$$Z_T = 6 + j3 + 20 - j15 \quad \checkmark$$

$$Z_T = 26 - j12 \, \Omega \quad \checkmark$$

$$I_T = \frac{V}{Z_T} = \frac{240 \angle 0^\circ}{26 - j12} \quad \checkmark$$

$$I_T = \frac{240 \angle 0^\circ}{28.6 \angle -24.78^\circ} \quad \checkmark$$

$$I_T = 8.4 \angle 24.78^\circ = 7.63 + j3.5 \, \text{A} \quad \checkmark$$

$$P = I^2 R \quad \checkmark$$

$$P = 8.4^2 \times 26 \quad \checkmark$$

$$P = 1513 \, \text{W} \quad \text{error carried forward}$$

$$S = V_{\text{rms}} \times I_{\text{rms}} \quad \checkmark$$

$$S = 240 \times 8.4 \times 7.63 = 1831.2 \, \text{VA} \quad \checkmark$$

$$PF = \frac{P}{S} = \frac{1513}{1831.2} \quad \checkmark$$

error carried forward

$$PF = 0.83 \quad \checkmark$$

Correct method.

Q112/30Q1a3/5

Q 1

b)

$$Z_1 = 25 + j35 + 65$$

$$Z_1 = 90 + j35 - j15 = 90 + j20$$

$$I_1 = \frac{V_s}{Z_1} = \frac{220 \angle 0^\circ}{90 + j20} = \frac{220 \angle 0^\circ}{92.2 \angle 12.5^\circ}$$

$$I_1 = 2.4 \angle -12.5^\circ \text{ units?}$$

$$S = V_{rms} \times (I_{rms})^* = 220 \angle 0^\circ \times 2.4 \angle 12.5^\circ$$

$$S = 528 \angle 12.5^\circ = 515.5 + j114.3$$

$$P = 220 \times 2.4 \cos 12.5^\circ$$

$$P = 515.5 \text{ W}$$

$$Q = 528 \sin 12.5^\circ = 114.3 \text{ VAR}$$

$$S = 220 \times 2.4 = 528 \text{ VAR}$$

$$Q = 528 \sin 12.5^\circ = 114.3 \text{ VAR}$$

Q 1b

9/25

error carried
forward

correct
method

5

correct method

Q2

a)

$$PF_1 = \cos \theta \quad \checkmark$$

$$PF_1 = 0.65 \quad \checkmark$$

$$\cos \theta = 0.65 \quad \checkmark$$

$$\theta = \cos^{-1} 0.65 \quad \checkmark$$

$$\theta = 49.45^\circ \quad \checkmark$$

$$S_1 = 120 \text{ KVA} \quad \checkmark$$

$$\cancel{Q_2 = 120 \times 49.45} \quad Q_1 = 120 \sin 49.45 \quad \checkmark$$

$$\cancel{Q_1 = 89.37 \text{ KVAR}} \quad Q_1 = 91.2 \text{ KVAR} \quad \underline{\underline{5}}$$

$$\cancel{P = 89.37 \text{ KW}}$$

$$P = 120 \cos 49.45 \quad \checkmark$$

$$P = 78 \text{ KW} \quad \checkmark \quad \underline{\underline{3}}$$

$$PF_2 = \cos \theta \quad \checkmark$$

$$PF_2 = 0.9 \quad \checkmark$$

$$\cos \theta = 0.9 \quad \checkmark$$

$$\theta = \cos^{-1} 0.9 \quad \checkmark$$

$$\theta = 25.84^\circ \quad \checkmark$$

$$PF_2 = \frac{P}{S_2} \quad \checkmark$$

$$S_2 = \frac{P}{PF_2} \quad \checkmark$$

Q219/25Q2a17/20

Q2

a)

$$S_2 = 78 \checkmark$$

$$(25.84) \times$$

$$S_2 = 3 \text{ KVA} \times$$

$$Q_2 = 3 \sin 25.84 \checkmark$$

correct method
error carried
forward

$$Q_2 = 1.3 \text{ KVAR}$$

2

$$Q = Q_1 - Q_2 \checkmark$$

$$Q = 91.2 - 1.3 \checkmark$$

2

$$Q = 89.9 \text{ KVAR} \checkmark$$

error carried
forward

$$Q_{\text{capacitor}} = \frac{(V_{\text{capacitor}})^2}{X_C} \checkmark$$

$$X_C = \frac{(V_{\text{capacitor}})^2}{Q_{\text{capacitor}}} = \frac{(220)^2}{89,900} \checkmark$$

$$X_C = 0.5 \text{ units } \underline{\underline{1}}$$

$$X_C = \frac{1}{2\pi f C} \checkmark$$

$$C = \frac{1}{2\pi f X_C} = \frac{1}{2\pi \times 50 \times 0.5} \checkmark$$

$$C = 6.4 \times 10^{-3} \text{ F}$$

2

$$C = 6.4 \text{ mF}$$

error carried
forward

Q2

b)

i)

?

0//

Q2b2/5

ii)

b

$$X_c = \frac{1}{2\pi f C} \checkmark$$

$$C = \frac{1}{2\pi f X_c} = \frac{1}{2 \times \pi \times 1.5 \text{ K} \times 114} = 9.3 \times 10^{-7} \text{ F}$$

2

~~from~~

Q3

a)

i)

$$V_{ab} = V \angle 0^\circ$$

$$V_{bc} = V \angle -120^\circ$$

$$V_{ca} = V \angle +120^\circ$$

$$V_{ab} = 220 \angle 0^\circ \text{ V}$$

$$V_{bc} = 220 \angle -120^\circ \text{ V}$$

$$V_{ca} = 220 \angle +120^\circ \text{ V}$$

5

ii)

$$I_{AB} = V_{ab} / Z_A$$

$$I_{BC} = V_{bc} / Z_A$$

$$I_{CA} = V_{ca} / Z_A$$

$$I_{AB} = \frac{220 \angle 0^\circ}{10 - j5} = \frac{220 \angle 0^\circ}{11.2 \angle -26.6^\circ} = 19.6 \angle 26.6^\circ = 17.5 + j8.8 \text{ A}$$

$$I_{BC} = \frac{220 \angle -120^\circ}{10 - j5} = \frac{220 \angle -120^\circ}{11.2 \angle -26.6^\circ} = 19.6 \angle -93.4^\circ = -1.2 - j19.6 \text{ A}$$

$$I_{CA} = \frac{220 \angle +120^\circ}{10 - j5} = \frac{220 \angle +120^\circ}{11.2 \angle -26.6^\circ} = 19.6 \angle 146.6^\circ = 16.4 + j10.8 \text{ A}$$

5

Q3

16/30

Q3a

14/15

Q3

a)

iii)

$$I_a = I_{AB} \sqrt{3} \angle -30^\circ$$

$$I_b = I_a \angle -120^\circ$$

$$I_c = I_a \angle +120^\circ$$

$$I_a = 19.6 \sqrt{3} \angle 26.6 - 30 = 33.9 \angle -3.4^\circ \text{ A}$$

$$I_b = 33.9 \angle -3.4 - 120 = 33.9 \angle -123.4^\circ \text{ A}$$

$$I_c = 33.9 \angle -3.4 + 120 = 33.9 \angle 116.6^\circ \text{ A}$$

4

Q 3

b)

i)

$$V_{an} = V_{\phi} \angle 0^\circ = 400 \angle 0^\circ$$

$$V_L = 400 \text{ V}$$

$$V_{bn} = V_{\phi} \angle -120^\circ = 400 \angle -120^\circ$$

$$V_{cn} = V_{\phi} \angle +120^\circ = 400 \angle +120^\circ$$

$$V_{\phi} = ?$$

ii)

$$I_a = V_{an} / Z_Y = 400 \div 6 + j6 = 8.48 \angle 90^\circ = 47.2 \angle 45^\circ$$

$$I_b = I_a \angle -120^\circ = 47.2 \angle 45^\circ - 120^\circ = 47.2 \angle -75^\circ$$

$$I_c = I_a \angle +120^\circ = 47.2 \angle 45^\circ + 120^\circ = 47.2 \angle 165^\circ$$

2

correct method
error carried
forward

error carried
forward

??

Q 3b2/15